Claims

1. A method for providing a simulation of a welding process using integrated models, the integrated models being interconnected by an interconnection tool to determine stresses and distortions of a material being welded, including the steps of:

determining a model of a geometry of the material;

defining a set of coordinates of elements and nodes of the geometry model for a finite element analysis mesh;

delivering the finite element analysis mesh coordinates to a thermal analysis model, the thermal analysis model including an analytical solution model and a finite element analysis model;

determining a thermal analysis of the welding process as a function of at least one of the analytical solution model and the finite element analysis model, the analytical solution model being adapted to provide a thermal history of the welding process for a global distortion analysis, and the finite element analysis model being adapted to provide a thermal history of the welding process for a detailed residual stress analysis;

delivering the thermal history of the welding process to a structural analysis model; and

providing a structural analysis of the welding process as a function of the thermal history.

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2. A method, as set forth in claim 1, wherein providing a thermal history of the welding process for a detailed residual stress analysis includes the step of providing a thermal history of the welding process for a specific portion of the welding process.

3. A method, as set forth in claim 1, wherein providing a structural analysis of the welding process includes the step of modeling a set of characteristics of the materials being welded during the welding process.

4. A method, as set forth in claim 3, wherein characteristics of the materials include residual stresses and distortions.

5. A method, as set forth in claim 1, wherein determining a thermal analysis of the welding process as a function of the analytical solution model includes the steps of:

determining a set of adiabatic boundary conditions of the material being welded;

determining a set of reflected heat sources as a function of the adiabatic boundary conditions;

determining a set of point heat sources as a function of the reflected heat sources; and

determining a total analytical solution from superposition of the point heat sources.

6. A method, as set forth in claim 1, wherein determining a thermal analysis of the welding process as a function of the finite element analysis model includes the step of determining a set of numerical computations of conditions at each desired node and element coordinate of the finite element analysis mesh.

7. A method, as set forth in claim 1, wherein delivering the thermal history of the welding process to a structural analysis model includes the step of delivering the thermal history by way of an interface module.

8. An apparatus for providing a simulation of a welding process using integrated models, the integrated models being interconnected by an interconnection tool to determine stresses and distortions of a material being welded, comprising:

a geometry modeler adapted to determine a model of a geometry of the material;

a meshing tool adapted to define a set of coordinates of elements and nodes of the geometry model for a finite element analysis mesh;

a thermal analysis model adapted to receive the finite element analysis mesh, determine a thermal analysis of the welding process, and responsively provide a thermal history of the welding process, wherein the thermal analysis model includes:

an analytical solution model adapted to provide a thermal history of the welding process for a global distortion analysis; and

a finite element analysis model adapted to provide a thermal history of the welding process for a detailed residual stress analysis; and

a structural analysis model adapted to provide a structural analysis of the welding process as a function of the thermal history.

9. An apparatus, as set forth in claim 8, wherein the interconnection tool is a graphical user interface.